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A Model for Increasing the Efficiency of Teaching Physics in High Schools with the Help of Cloud Technologies

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Abstract: This article presents the possibilities, methods of use of modern educational technologies in the development of the competences of high school students in physics, and the model of developing the skills of students to independently complete the tasks given in theoretical, practical, laboratory, and group classes during the lesson and outside of the lesson. Experiments were also carried out in order to determine the level of efficiency of the proposed model. The results obtained in the experiment were analyzed using the chi-square test.

Keywords: physics, cloud technology, Google Classroom, Case-Study, Assessment, model, chi square.

Introduction. Today, the development of an effective mechanism for introducing information technology tools, including cloud technologies, into the education and training process is one of the important problems of education [1]. In this regard, the No.5847-decree of the President of the Republic of Uzbekistan dated October 8, 2019 "On approval of the concept of the development of the higher education system of the Republic of Uzbekistan until 2030". Also, priority tasks such as the implementation of the "E MINBAR" platform, which allows online monitoring and mastering of lessons, and uploading them to electronic information storage devices, are defined [2]. Therefore, improving the methodology of using cloud technologies in teaching subjects, especially physics, in secondary schools remains one of the urgent issues.

Analysis of literature on the topic. One of the main technologies that can affect the solution of relevant (pedagogical, psychological and technical) problems in the process of education and training is cloud technologies. The theory and methodology of introducing cloud technologies, the implementation of the methodology of using digital technologies in the educational process, and the researches related to the problems of distance education were carried out by our country and foreign scientists A.A. Abdukadirov, U.Sh. Begimkulov, R.H. Joraev, N.I. Taylakov, A.I. Gazeykinoi, A.A. Zaslavskogo, S.M. Larionova, D.N. Monakhova, A.V. Slepukhina, M.V. Stupinoy, N.T. Although some approaches regarding the use of cloud technologies to solve pedagogical and organizational problems regarding general education and higher education have been put forward by Sukhanovoy and others, in their scientific research, the methodology of using cloud technologies is sufficient for effectively organizing theoretical, practical and laboratory classes in physics of high school students. not studied to the extent [3].

Research methodology. Modern educational technologies form a specific didactic system aimed at ensuring the interest of young students in science, the quality of education, and the elimination of methodological problems in teaching science, as well as educational needs. On the basis of modern educational technologies, it is important to develop students' science-related skills, including the ability to solve physical problems of high school students. Therefore, it is necessary to improve the forms, methods and means of introducing modern educational technologies in teaching physics to high school students.

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1-расм

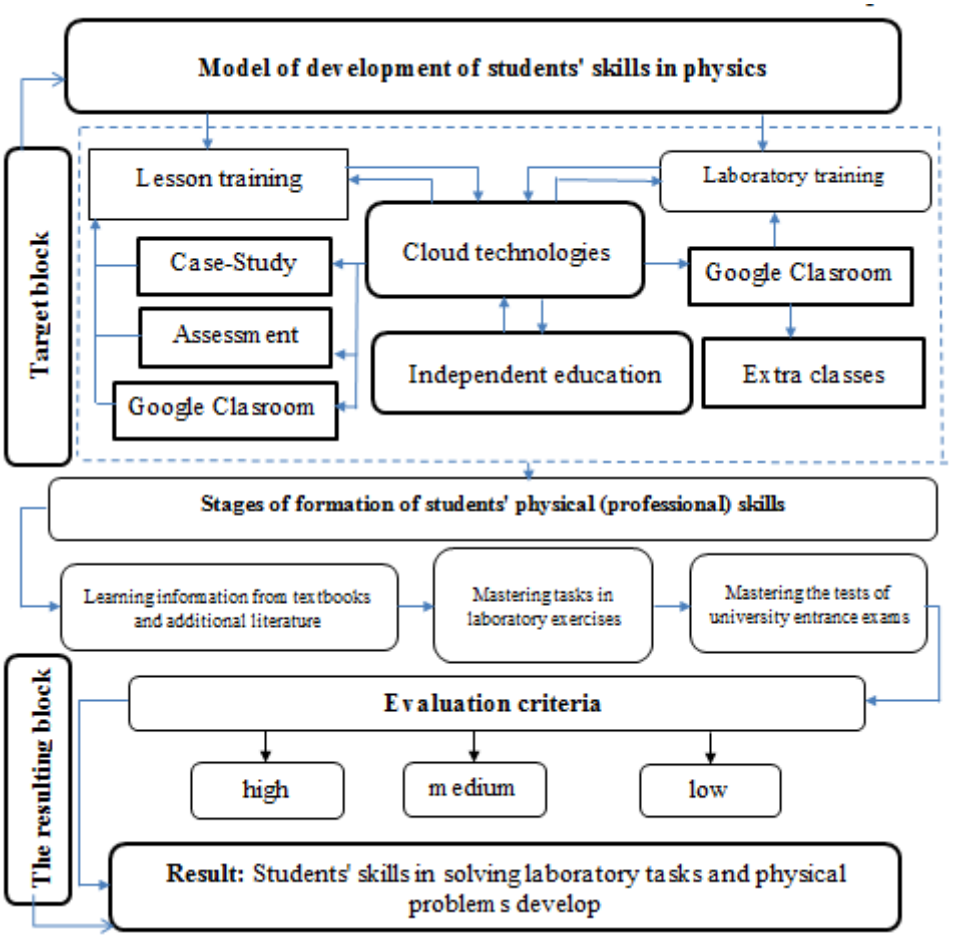

Figure 1. Model of development of students' skills in physics

For this, it is necessary to develop a model of physical skills development of students based on cloud education technologies. Therefore, within the framework of the research, a model of the development of professional skills of students taught in physics in secondary schools was developed (see Figure 1).

The mentioned model envisages the use of theoretical, practical and laboratory classes of physics taught in upper classes of general education schools based on innovative educational technologies, in particular cloud, Case-Study, Assessment technologies, as well as the GoogleClassroom educational platform. It is decided to use Assessment technology in the organization of laboratory and group classes of students in physics. It is important to pay attention to the theoretical, practical, laboratory training of physics taught in the upper classes of general education schools, as well as independent activities of students in this subject during extracurricular activities. Therefore, we recommend the use of cloud technologies and the GoogleClassroom educational platform for students' theoretical, practical, laboratory exercises and independent learning of physics assignments.

When it is called cloud technologies, it is necessary to understand the model of the systems of procedures that ensure the change of material and ideal (virtual) objects in accordance with the purpose. There are different ways to use cloud services in education. In "Cloud" the teacher will have the opportunity to place the text of the lessons, tests, video and audio materials, cases, assessments. Also, students will have the opportunity to check various tools for assessing their knowledge, such as control and tests, through a browser without downloading a file to a computer. The reader, student will have the opportunity to read, view, listen to information in any convenient form on a computer or phone, and even answer test or control questions. The main thing is the advantages and cheapness of "Cloud" services in the implementation of the educational process. Windows operating system is installed on personal computers at home.

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Therefore, if students do homework and practical work on the same software on the school computer, they will have to continue the practical activity at home or use different software for homework. Cloud technologies have the potential to solve these problems and create convenience for both the student and the teacher in the process. Therefore, we recommend the use of cloud technologies for the subjects taught in general education schools, especially physics.

Case-Study technology is one of the problem-based educational technologies, and it is an educational technology aimed at solving methodological problems in teaching and organizing education in teacher-student cooperation. The application of Case-Study technology to physics is considered to be relatively simple and can be used without difficulty by a teacher who does not have high qualifications. Looking at the history of Case-Study technology, this technology was developed by M. Shaver, F. The Case-Study method, developed by Edey and C.Eats, was first used in 1910 in the teaching of management sciences at Harvard Business School, which is famous for innovation [4]. Since the second half of the 90s of the 20th century, Case-Study technology has been widely used in the educational system of all developed countries [5].

Case-study technology is a teaching technique that uses the description of economic, social and specific problem situations, which requires students to analyze the situation, understand the nature of the problems, propose possible solutions and choose the best one [6]. In this regard, according to M.A. Lavrikova, in Sase-Study technology, situations involving social, economic or political problems are presented using the technical means of oral and written teaching. When this technology is used in teaching subjects, including physics, the following opportunities are created [7]:

- enriches students' analytical, creative, critical outlook;
- forms the culture of students to find alternative solutions to problems;
- develops students' decision-making skills;
- forms the culture of students working in a group.

According to E.V. Butyleva, the Case-Study technology is an analysis of a specific situation, increases the motivation to increase the acquired knowledge of science and its practical application. It also directs each student to participate to the maximum extent to solve the problem or task. As a result, students achieve the following results [6]:

- Analysis of given data;
- using data to isolate the main problems;
- choosing the best overall solution, etc.

Based on the analysis of the opinions of the cited scientists, it can be concluded that it is appropriate to use the Case-Study technology in the teaching of physics and in the development of students' problem-solving skills, understanding and retention of theory, and integration with the sciences. Therefore, it is important to use interactive methods of teaching, in particular Case-Study technology, in the process of mastering physics by students. With the help of this technology, it simultaneously reflects not only a vital problem (solving methodological problems), but also updates the set of certain knowledge that should be obtained when considering a problematic topic of science, and also successfully combines educational, analytical and educational activities.

In turn, it serves as an active and effective tool in the implementation of modern tasks of the educational system [8]. Along with effective organization of physics lessons in general education schools, it is important to organize laboratory activities as well. Therefore, we recommend using the Assessment method when organizing laboratory classes in physics.

The assessment method is a set of tasks designed to rationally evaluate the level of development of students' knowledge, skills, skills and competence in laboratory classes in physics. may consist of presentations, crosswords, role-playing and business games. Therefore, it is effective

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to use the assessment technology at all stages of laboratory training in physics (at the beginning or end of the lesson or when any section of the subject is completed) to assess the mastery of the subject. It is necessary to follow certain principles and requirements in teaching the assessment method [9]. In this regard, it is appropriate to rely on the principles recommended by S.V. Burmistrov, S.A. Tikhonovskova, S.I. Samygin:

- taking professional requirements into account;
- paying attention to the behavior of the participants;
- assess the behavior of the participants only in the context of a specific situation of real activity;
- all participants, observers should have complete information about the main goals, procedure and importance of the method;
- at the end of the training, feedback is given to each participant based on his behavior;
- preliminary selection of employees and coordination of subsequent training activities with each other;
- the process of implementing the training procedure should be carried out under flexible guidance [10].

Thus, we recommend using the Assessment method to effectively assess students' knowledge and develop their competence by using it in the organization of laboratory classes in physics.

The **Google Clasroom** educational platform is a free online service for organizing distance education provided by the Google company. Through this platform, the teacher can create his course, invite users to classes, share the necessary files, set evaluation criteria for the test, schedule video meetings in the calendar, and show the presentation during the online broadcast. Forms of organizing training in Google Clasroom:

- teacher-student;
- teacher, student, parent, class leader (responsible administration)

The Google Classroom educational platform defines its functional tasks for each category of learners as shown in Table 1 [11].

1-table

Teacher	Creates assignments. Supervises assigned tasks. Evaluates according to the level of performance, explains the shortcomings and errors.
Pupil	Monitors tasks, assignments, and exchange information on assignments by e-mail. Submits completed tasks, receives teachers' grades and comments.
Class instructor parents	Sends notification to parents about student's progress, late work, and soon submission information. Parents cannot enter the classroom, they can leave a message to the class teacher by e-mail.
Responsible administration (Administrator)	Create, track and delete each class domain. Attach and remove students and teachers within classes. View all class work in the domain.

Table 1. Google Classroom features for learners

In Google Classroom, given its high integration with other Google services and partners, it is possible to create and use a variety of tasks, including text documents, presentations, tables, cases, assessments. A detailed guide to creating assignments in Google Classroom can be found at this link: https://support.google.com/edu/clasroom/?hl=ru&authuser=0#topic=9044978

We recommend using the Google Classroom technology to create assignments of various types from theoretical, practical, and laboratory classes in physics taught in upper grades of general

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education schools. This, in turn, not only increases students' interest in science, but also serves to form independent learning skills.

It is important to organize theoretical, practical and laboratory classes in physics on the basis of the mentioned innovative educational technologies. On the basis of information technology tools, in particular, through the use of video lectures, presentations, electronic tests, it is possible to organize physics lessons more effectively and interestingly.

Analysis and results. Experiments were conducted in order to determine the level of efficiency of the model of effective organization of theoretical, practical and laboratory training of students in physics based on cloud-based educational technologies. Experimental work was carried out in Specialized State Schools (8, 11, 12, 16) in Navoi city of Navoi region and in schools of Pakhtachi district (3, 5, 10) of Samarkand region. Students were divided into experimental and control groups. Students allocated to the experimental group were used the model developed in the framework of the study

The control group was not given this opportunity. Mathematical-statistical analysis was carried out using the chi-square criterion of the efficiency level of experimental work. When using this criterion, appropriate mean values $\overline{X} = \frac{1}{n}\sum_{i=1}^{4} n_i X_i$ were used for the samples and variance $D_n = \sum_{i=1}^{4} \frac{n_i (x_i - \overline{X})^2}{n-1}$ formulas. According to the results of the calculation, it was found that the average mastery level of the experimental group was higher than that of the control group, that is, it increased by 9.1 percent.

Conclusions and suggestions. Cloud technologies significantly improve and simplify interactions between all participants of the educational process. Nevertheless, one of the important issues is the use of such technologies in organizing the joint work of future physics teachers in general education schools and providing comprehensive training of teachers.

I believe that it is necessary to use the offered modern educational technologies, cloud, Google Classroom, Case-Study and Assessment technologies in organizing lessons and teaching subjects.

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